

## Short Report: Annual Burden of Ocular Toxoplasmosis in the United States

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**Abstract.** Toxoplasmosis is the most common retinal infection in the United States, and it can severely impact vision. We used data from population-based studies, outbreaks, and the U.S. census to estimate the burden of *Toxoplasma gondii* infection and ocular toxoplasmosis. We estimate that 1,075,242 persons are infected with *T. gondii*, 21,505 persons have ocular lesions (both asymptomatic and symptomatic), and 4,839 (range = 2,150–7,527) persons develop symptomatic ocular toxoplasmosis each year in the United States. Toxoplasmosis contributes a significant burden to eye disease in the United States.

Toxoplasmosis is the most common retinal infection in the United States, and it can lead to severe visual impairment. It is generally believed that individuals remain infected with *Toxoplasma gondii* for life with intracellular cysts forming in the muscles, brain, and other organs. *T. gondii* IgG antibodies are also thought to remain for life. In 2003, Holland<sup>1</sup> estimated the burden of ocular toxoplasmic eye lesions in the United States based on data from the third National Health and Nutrition Examination Survey (NHANES III), conducted in 1988–1994, and the 2000 census.<sup>1,2</sup> We now present an update of the ocular toxoplasmosis burden based on more recent NHANES and U.S. population data.

For the burden calculations, we used (1) *T. gondii* antibody seroprevalence data from the NHANES 1999–2004<sup>3</sup> to determine *T. gondii* infection rates, (2) 2009 U.S. Census estimates,<sup>4</sup> (3) calculations of the proportion of persons with *T. gondii* infection who have ocular lesions from estimates by Holland,<sup>1,2,5</sup> and (4) the prevalence of symptomatic ocular disease from a large waterborne outbreak of toxoplasmosis in Canada<sup>6</sup> to estimate the rate of symptomatic disease in infected persons. We also provided ranges for the estimate of symptomatic ocular toxoplasmosis (Table 1).

**Annual number of *T. gondii* infections.** Based on the NHANES 1999–2004, at least 14% of persons in the United States are infected with *T. gondii* by age 40 years.<sup>3</sup> For the purposes of this calculation, we assumed an equal infection rate per year of age, yielding 0.35% (14/40) of the population infected each year. Using the 2009 U.S. Census estimate of 307,212,000 people,<sup>4</sup> we estimate that 1,075,242 persons (0.0035 × 307,212,000) are infected with *T. gondii* each year.

**Ocular lesions among those infected with *T. gondii*.** Using data about the proportion of persons with retinal scars from Smith and Ganley<sup>5</sup> and the prevalence of *T. gondii* infection during their study, Holland<sup>1</sup> calculated a rate of ~2% for the occurrence of ocular disease among persons infected with *T. gondii*. If we apply this 2% figure to the 1,075,242 persons infected with *T. gondii* each year calculated above, then 21,505 persons would have ocular lesions from *T. gondii* infection each year. For the purposes of this estimate, we assumed that individuals develop ocular lesions within 1 year of infection.

**Symptomatic ocular disease among persons infected with *T. gondii*.** During an outbreak of toxoplasmosis in British Columbia, of an estimated 2,900–7,700 infected persons, 19 were identified with symptomatic retinitis, yielding a rate of 0.2–0.7% for symptomatic retinitis among persons infected with *T. gondii*.<sup>6</sup> If these rates are applied to the 1,075,242 persons per year infected with *T. gondii* from the calculations above, then 2,150–7,527 (midpoint = 4,839) persons would develop symptomatic ocular toxoplasmosis annually.

We estimate over 21,000 persons will develop *T. gondii* ocular lesions and over 4,800 of these individuals (median estimate) will develop symptomatic ocular toxoplasmosis in the United States in 2009. Ocular toxoplasmosis often recurs with new lesions developing over the years after infection, so the annual incidence of active ocular lesions could exceed our calculations. In addition, the researchers determining the rate of symptomatic disease in the outbreak of toxoplasmosis in British Columbia could not be certain that all persons with ocular toxoplasmosis in this large outbreak were identified (Andrew Burnett, personal communication), and therefore, our estimates of symptomatic ocular disease should be considered minimum estimates. Although unique factors associated with the epidemic could influence the ratio of symptomatic to asymptomatic disease, we believe that our assumptions have led to reasonable estimates; it is known that many individuals are found to have ocular lesions without histories of ocular symptoms.<sup>1</sup>

Some areas of the world such as Southern Brazil<sup>7</sup> have much higher rates of ocular toxoplasmosis among those infected with *T. gondii*, perhaps because of more virulent strains of the organism.<sup>8–10</sup> In addition, the prevalence of *T. gondii* infection varies greatly with high rates in Latin America, parts of Eastern/Central Europe, the Middle East, and parts of Southeast Asia and Africa and lower rates in many European countries and the United States.<sup>11</sup> Therefore, the proportion of persons in the population with ocular toxoplasmosis will vary greatly by geographic location.

Ocular toxoplasmosis can be the result of pre- or post-natal infection, but, in either case, many infections with *T. gondii* are preventable by simple hygienic measures such as cooking meat well, washing hands after changing cat litter or gardening, and washing fruits and vegetables that will be eaten raw.<sup>12</sup> Treatment of ocular toxoplasmosis is generally recommended when lesions are large or threaten the central portions of the retina. A number of regimens have been used for treatment,<sup>13</sup> such as pyrimethamine and sulfadiazine with or without corticosteroids. However, additional well-controlled trials are

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TABLE 1

Summary of *T. gondii*-related infections and ocular disease annual burden calculations in the United States in 2009

Parameter	Estimate (persons/year)
<i>T. gondii</i> infections	1,075,242
Ocular toxoplasmosis lesions	21,505
Symptomatic ocular toxoplasmosis	4,839*

\* Range = 2,150–7,527.

needed to establish the efficacy of treatment, the optimal medications, and the duration of therapy.<sup>14</sup> Although ocular lesions initially can be asymptomatic, individuals can eventually have profound vision loss from recurrent ocular toxoplasmosis, even with treatment, emphasizing the critical importance of disease prevention. Information about the burden of both symptomatic and asymptomatic ocular disease is useful for establishing public-health measures to effect such prevention.

Received November 5, 2009. Accepted for publication November 29, 2009.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Department of Health and Human Services or the Centers for Disease Control and Prevention.

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